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**MARITIME TACTICAL UNMANNED AERIAL SYSTEMS (TUAS) IN NAVY
STRIKE GROUPS CAN IMPROVE MARITIME DOMAIN AWARENESS FOR THE
OPERATIONAL COMMANDER**

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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ABSTRACT

The U.S. Navy needs to overcome tactical ISR asset shortfalls resident in deploying strike groups so they are better able to support the Maritime Domain Awareness (MDA) picture of the operational commander. MDA is the key to providing combatant commanders the necessary information to make effective decisions against maritime threats to help maintain political and economic stability in volatile regions around the world. The solution to this tactical ISR shortfall is Tactical Unmanned Aerial Systems (TUAS). The capabilities of TUAS to fulfill tactical ISR requirements have been demonstrated repeatedly, on multiple Navy combatants over the past several years. Naval Strike Groups are routinely deployed without these requisite organic tools to achieve persistent maritime surveillance and the addition of TUAS can correct that deficiency and help achieve knowledge and information superiority for Maritime Domain Awareness at the tactical and operational level.

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INTRODUCTION

The 21st century has ushered in a new era of maritime challenges for the United States and the Navy. The Cold War conventional blue water threat in the later half of the 20th century has been superseded by global, asymmetric, non-state actors who threaten the security of world ports and shipping on the high seas and in littoral waters, potentially jeopardizing global economic stability.¹ This ambiguous and dynamic maritime environment has made identifying the enemy at sea more complex because the terrorist threat can come from any maritime vessels regardless of size. The attack on USS *COLE*, in 2000, and the continuous acts of piracy seen off the coast of Somalia today are examples of this. The days of focusing on peer competitor grey military hulls has given way to the requirement of having awareness of all things maritime in the aquatic domain. This need for global Maritime Domain Awareness (MDA) has brought to light shortfalls in organic Intelligence, Surveillance and Reconnaissance (ISR) collection capabilities within the Navy.² Currently, naval strike groups are routinely deploying in support of combatant commanders without the requisite organic tools to achieve persistent maritime surveillance and information superiority. There are insufficient organic ISR assets available to support Strike Group Commanders, as documented in post deployment strike group lessons learned.³

The focus of this paper is to examine how the Navy can mitigate strike group ISR shortfalls through the expanded use of tactical unmanned aerial systems (TUAS) to achieve knowledge/information superiority in support of operational commander MDA requirements. This paper will review the genesis of the U.S. MDA requirement to better comprehend why ISR information needs have increased. A critical analysis will be conducted on the impact of organic ISR capability shortages on naval strike group operations in support of the combatant

commander MDA requirements. Finally, recommendations will be made on how to overcome these ISR capability shortages through TUAS employment to better achieve MDA for the operational commander.

MARITIME DOMAIN AWARENESS HISTORY

The post September 11, 2001 era brought about significant change for the United States in the maritime arena. As a result of the 9/11 attacks, comprehensive reviews were conducted on U.S. intelligence failures and the inability to protect the homeland, resulting in sweeping changes to correct both.⁴ As part of these corrective actions, President George W. Bush created the Department of Homeland Security and began promulgating National Security and Homeland Security Presidential Directives to provide policy and guidance across a myriad of security areas to begin a deliberate process of improving the security of the United States against all potential threats.

National Security Presidential Directive-41 (NSPD-41)/Homeland Security Presidential Directive-13 (HSPD-13), signed December 21, 2004, were two of these new security directives focused on maritime security and establishing the United States Maritime Security Policy which stressed the importance of securing the Maritime Domain.⁵ In this policy the Maritime Domain is defined as “All areas and things of, on, under, relating to, adjacent to, or bordering on a sea, ocean, or other navigable waterways, including all maritime-related activities.”⁶ The desired end state of the National Strategy for Maritime Security is to protect U.S. national and global maritime interests by safeguarding the ocean and its resources and preventing attacks against the United States by enhancing threat and situational awareness across the maritime domain.⁷ These maritime security threats can

include illegal seaborne immigration, environmental destruction, and illegal or destructive acts perpetrated by nation-states, terrorists, transnational actors and pirates.⁸

In October, 2005 the White House unveiled the *National Plan to Achieve Maritime Domain Awareness*, one of eight implementation plans under the new *National Strategy for Maritime Security*⁹ This implementation plan was assigned to the Secretaries of Defense and Homeland Security and it would “lay the foundation for an effective understanding of anything associated with the Maritime Domain that could impact the security, safety, economy, or environment of the United States and identifying threats as early and as distant from our shores as possible.”¹⁰ This implementation plan emphasized that MDA will be achieved by improving the ability to collect, fuse, analyze, display and disseminate actionable information and intelligence to operational commanders.¹¹ Additionally, the plan stated:

To achieve persistent awareness in the maritime domain, Cold War legacy collection capabilities alone are no longer sufficient. We must reorient and integrate these legacy systems with current and emerging capabilities, such as unmanned aerial vehicles and acoustic sensors, fused in a common operating picture available to maritime operational commanders and accessible through the United States Government. Employment of these collection capabilities will maximize near-real time awareness of maritime threats.¹²

In May 2007, the Chief of Naval Operations (Admiral Mullen) approved the *Navy Maritime Domain Awareness Concept* which provided guidance on Navy efforts to improve MDA related capabilities and develop related Fleet Concepts of Operations.¹³ This MDA concept is in support of both NSPD 41 and the *National Plan to Achieve Maritime Domain Awareness* with a timeline for implementation completion set at ten years (2017). This MDA Concept acknowledges the Navy’s growing operational focus beyond traditional blue water threats and activities to a more non-traditional, littoral focus.¹⁴ These efforts involve the

securing of the maritime commons for economic and political stability. This focus on global maritime commerce in and around the littorals creates a much larger volume of shipping to track and monitor, thus creating a greater challenge for the Navy to maintain a coherent common operating picture (COP) of surface vessels at the tactical and operational level. MDA is intended to maximize the visibility of the entire massive global maritime realm so operational commanders can effectively conduct mission sets throughout the Range of Military Operations (ROMO) to achieve national and global maritime security. If a poor COP prohibits MDA for the operational commander because of the lack of organic strike group ISR assets to deconflict the littorals, then this inhibits mission success.

The Navy MDA Concept states that “MDA has application at the Tactical, Operational and Strategic levels of command.”¹⁵ All three of these levels must be interconnected with a Command and Control (C2) structure that enables vertical, two-way flow of MDA information between these levels as well as horizontally across to other services, government agencies and coalition partners throughout the three tiers of command. This is how global MDA is built and maintained, a sharing of information and knowledge about activities, resources and shipping in the maritime domain. This C2 structure and the organic ISR asset shortfalls are at the heart of the Navy’s challenges in achieving MDA.

NAVY’S MARITIME DOMAIN AWARENESS CHALLENGES

MDA requirements have significantly opened the surface contact management aperture for the Navy. The increased focus in the littorals and expanding threat base of maritime platforms have created significant challenges for the Navy regarding organic ISR assets and C2 structure. The Navy’s MDA Concept describes the situation this way: “The capability to process maritime information has not kept pace with the increase volume, and

the number of organic reconnaissance assets available to gather this information has declined.”¹⁶ Figure 1, from the MDA Concept, illustrates this challenging trend showing the increase in the number of maritime platforms as the focus broadens on the littorals over time, with insufficient data processing capability, and diminishing numbers of organic reconnaissance assets to conduct ISR contributing to a comprehensive maritime COP.

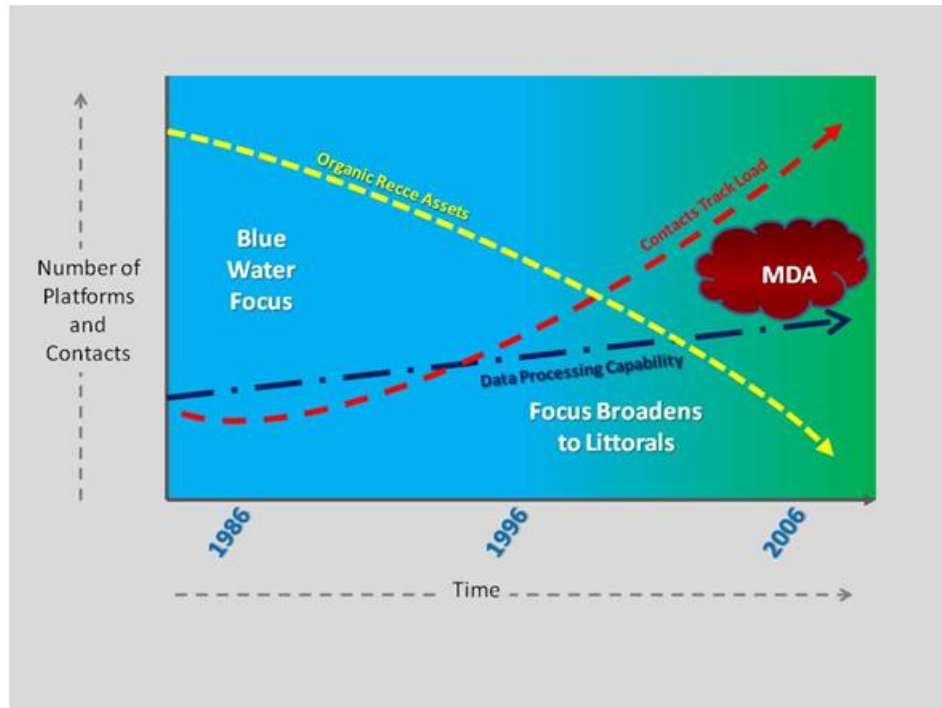


Figure 1: MDA Concept Trend Analysis¹⁷

The rapid expansion of global commerce has contributed to a significant increase in the number of vessels sailing the world’s waterways with many of these transiting from loosely governed nations, while at the same time U.S. ISR capabilities to monitor and track these ships continues to decrease.¹⁸ The Navy is lacking in the capability to detect, identify, track and understand this large volume of small ships in the global littoral waters, including off the coasts of the United States, making this a critical vulnerability.¹⁹ The magnitude of the gap is such that increasing force structure to overcome it would be unaffordable.

Innovative solutions utilizing technology like tactical unmanned aerial systems in the maritime domain can help overcome this capability gap. Rear Admiral Gortney, Carrier Strike Group 10 Commander, stated at the American Society of Naval Engineers (ASNE) Combat Systems Symposium in Dec 2006 that: "...persistent ISR is a fundamental challenge to naval forces and overdue for resolution. Simple solutions, such as ScanEagle (TUAS) are better because of their versatility, they can go on a wide variety of ships including the DDG 51.”²⁰

Why does MDA present such a challenge? The world's oceans are vast, open maritime highways easily accessible by anyone with a vessel and can travel in international waters with minimal oversight. Unlike the world's airways where established air routes and strict ground control procedures regulate, track and monitor the skies, the maritime environment lacks a rigid structure for identifying and tracking all vessels. One organization that provides maritime guidance is The International Convention for the Safety of Life at Sea (SOLAS) which is an international treaty concerning the safety of merchant ships that has been in existence for over 90 years.²¹ In 2000, SOLAS adopted a new requirement for all ships of 300 gross tonnages or more on international voyages, cargo ships of 500 gross tonnages or more not engaged on international voyages, and all passenger ships regardless of size, to be fitted with an Automatic Identification System (AIS) to automatically provide information about the ship to other ships and coastal authorities.²² This new requirement has contributed significantly to improving MDA for larger vessels but there are no such requirements for the vast number of remaining maritime crafts. Until an international AIS requirement for all boats and ships is implemented, which is unlikely due to cost and

international enforcement issues, resolving the maritime picture will continue to be challenging.

The U.S. Navy's mobility, access and combat power make it the cornerstone of Maritime Domain Awareness for the United States. Its inherent expeditionary capability allows it to provide the reach and access to affect both the national and international components of MDA through its ability to deploy tailored naval forces in the form of Carrier Strike Groups (CSGs), Expeditionary Strike Groups (ESGs), or Surface Strike Groups (SSGs) near the United States, in overseas littorals and in the open sea.²³ It is imperative these strike forces have the organic ISR tools to help the operational commander achieve MDA. The objective of MDA is to generate actionable intelligence through information superiority to thwart or combat hostile maritime entities. With actionable intelligence, the range of options available to Navy forces and the operational commander expands significantly enabling more effective investigation and interdiction of potentially threatening vessels overseas or as they approach the United States.²⁴

ISR ORGANIC SOLUTIONS: TACTICAL UNMANNED AERIAL SYSTEMS

Tactical Unmanned Aerial Systems (TUAS) are key force-multipliers in the areas of ISR, Signal Intelligence (SIGINT), target acquisition and designation, and weapons engagement. TUAS provides an organic capability to Strike Groups that is relevant throughout the entire range of military operations from major combat operations to stability, humanitarian relief operations and homeland defense missions. This organic capability is vital to achieving operational commander requirements for MDA.²⁵

TUAS provide the operational and tactical commander a large range of options that are well suited to missions and tasks over manned aircraft that involve the 4-Ds: dull,

dangerous, dirty and deep. Dull missions/tasks require persistent presence over days, weeks or months. Dangerous missions/tasks require a high degree of risk and the commander's willingness to risk an asset may be greater when no human life is involved. Dirty missions/tasks are those carried out in a hazardous environment such as CBRN. Deep missions/tasks are those beyond the range of tactical manned platforms.²⁶ The sensor packages on TUAS to support any one of these missions can vary dependent on requirements but include the full range of ISR sensor options to include electro-optical (EO), infrared (IR), synthetic aperture radar (SAR), inverse synthetic aperture radar (ISAR), maritime moving target indicator (MMTI), light detection and ranging (LIDAR), chemical, biological, radiological, nuclear or high yield explosive (CBRNE) detection, automated identification system (AIS), signals intelligence (SIGINT), and laser range finder/designator (LRF/D) capabilities.²⁷ This wide range of sensor payloads for TUAS provides naval ships a menu of options for building the MDA picture by obtaining the desired information to best identify and understand an unknown surface contact's capabilities and intentions.

TUAS are needed in all three different naval strike groups; carrier, expeditionary and surface. CSGs require significant ISR support not only for force protection of this national asset but also to supplement manned aircraft and helicopters (helos) conducting surface surveillance when the carrier is outside of the twelve hour flight cycle. The retirement of the S-3 Viking as a dedicated organic surface surveillance aircraft in CSGs has created a huge ISR void. Though F/A-18 Hornets have picked up the S-3 mission, surface surveillance is truly a tertiary duty for them with no ISR equipment onboard other than infrared thermal imaging cameras (FLIR).²⁸ The loss of S-3s is an additional reason why TUAS are needed in CSGs to supplement this capability. ESGs are more ISR challenged than CSGs because of

the reduced number of aircraft they possess and lesser onboard capabilities. ESGs consistently request TUAS support prior to deployments to mitigate ISR shortfalls but funding constraints and asset availability have traditionally negated these request.²⁹ Finally, SSGs are most in need of TUAS because of the very limited air assets available to them. A surface strike group may consist of a single, independent deployer with no embarked helo, making TUAS even more vital. Overall, the biggest problem for all strike groups after deploying is the aggregation/disaggregation of forces once they arrive in theater because of the multitude of mission/task requirements the operational commander has for the strike group throughout his area of responsibility. Strike group assets are routinely dispersed to meet operational, exercise and Theater Security Cooperation (TSC) requirements, so any ISR capability inherent to a particular unit in support of the strike group is lost during the disaggregation period. This is one of the biggest driving factors for having TUAS assets on all small deck capital ships (CG, DDG, FFG, LPD, LSD, LCS, HSV) to ensure ISR assets are available at the tactical level to meet operational level requirements. A great example of this is a DDG detached from the CSG to conduct maritime security operations off the Horn of Africa. If this DDG has TUAS embarked, then this minimizes the ISR support requirements from Navy Central Command (NAVCENT). In fact, this DDG will be able to provide sufficient ISR support back to NAVCENT allowing them to reapportion their land based ISR assets for other priority missions. The 2007 deployment of USS *OSCAR AUSTIN* to the Central Command (CENTCOM) AOR with TUAS is a perfect example of how this onboard ISR capability could better support the operational commander as discussed in their classified post deployment brief.³⁰ CENTCOM now has a standing requirement approved by the Joint Staff for this organic ISR capability in theater.

TUAS provides the operational commander the capability to conduct overland reconnaissance in urban and rural environments, and surveillance and protection of critical maritime infrastructure such as port facilities and oil platforms by providing real time monitoring and indications and warnings of approaching threats.³¹ Recent examples of TUAS deployments demonstrating support to the combatant commander include the 2005 deployment of USS *CLEVELAND* to CENTCOM providing protection of the Iraq oil platforms with TUAS by sending real time images of enemy combatants to coalition force ships conducting maritime security operations.³² In support of Pacific Command (PACOM) in April 2007, USNS *STOCKHAM* used TUAS to assess damage from an earthquake and tsunami along the shoreline of the Solomon Islands in conjunction with U.S. Department of State and non-governmental organizations' humanitarian assistance operations.³³

TUAS is a time-space-force multiplier for strike groups while conducting ISR in support of MDA requirements for the operational commander. TUAS is capable of remaining on station 6-20 hours (dependent on TUAS platform) without refueling providing persistent ISR coverage. Conversely, organic manned aircraft/helos only provide 2-3.5 hours. Though the combat radius of TUAS is shorter (60-150 nautical miles (nm)) as compared to manned aircraft/helos (150-500nm), this often is not a factor when operating in the confined spaces of the littoral where persistent coverage outweighs range. Finally, the presence of TUAS to conduct persistent ISR missions frees up manned aircraft/helos at the tactical and operational level for higher priority missions/tasks that require a manned cockpit helping to achieve a better distribution of forces in support of operational tasking.

The use of TUAS ISR video by the operational commander for Information Operations (IO) is another critical use. Today's information age demands pictures and

video as a source of power to inform and act on. Visual images are used to generate a perception, garner an emotion, or most importantly, to influence decision makers. Using TUAS to record tactical actions at sea to show the cause and affect of operations can be very beneficial to help garner support at home in the United States, while deterring the enemy abroad. Terrorist organizations have mastered this IO art, which is why the operational commander must have the tools in place to do the same.

The unmanned aspect of TUAS has advantages over manned aircraft including longer on station time, no onboard crew rest issues, and flexibility in dynamic re-tasking with multiple payloads. With no onboard manned support equipment requirements, TUAS requires a significantly less amount of fuel to operate because of size and weight reduction contributing to cost effectiveness and reduced operational logistics for the commander. Persistent unmanned aerial systems are designed to exceed human limitations and to loiter for extended periods of time, requiring breaks only for refueling and routine or emergency maintenance.”³⁴ The fact that TUAS is small and light gives it a low aural, visual and radar signature making it very survivable. When operating above 3000 feet it is virtually inaudible or visually undetectable from the ground making it an excellent low level ISR platform.³⁵

ISR satellite coverage over many parts of the world’s oceans is spotty at best since these assets are traditionally focused over land masses. TUAS can provide more responsiveness and persistence than satellites in many of the more remote ocean areas where naval forces are tasked to travel. Limited satellite coverage of vast oceans highlights the greater importance of TUAS assets on Navy ships throughout the world. Additionally, the availability of satellite ISR support is very difficult to obtain due to limited resources and

higher national priorities. The organic nature of TUAS provides the tactical and operational commanders with an ISR asset they can control.

TUAS are instrumental in Visit, Board Search, and Seizure (VBSS) /Maritime Interdiction Operation (MIO), providing visual identification and surveillance of the target of interest via a live feed to the tactical commander. This streaming video can then be forwarded via SIPRNET to operational intelligence centers for analysis and database collection. TUAS should be added to the suite of enhanced maritime interdiction tools that Navy boarding teams can utilize for force protection and better intelligence support for MIO operations at the tactical and operational level.

The Navy's operating concepts today require naval ships to operate both independently and within the strike group framework to support the operational commander. TUAS provides the means by which these units gather intelligence to support strikes, cue force protection assets and target long range fires in support of expeditionary and Special Forces. Most importantly, TUAS provides the organic ISR capability these strike groups are lacking to support operational commander MDA needs.

TACTICAL UNMANNED AERIAL SYSTEMS SHORTFALLS

Tactical Unmanned Aerial Systems clearly have their shortfalls. One of the biggest Achilles heels of TUAS is communications and bandwidth management. If the control station onboard the controlling ship cannot talk to the vehicle then TUAS cannot perform its mission and a complete loss of communications can even potentially result in the loss of the unmanned aircraft.³⁶ TUAS is limited to line-of-sight operations which can impose range and altitude restrictions in order to maintain communications throughout the flight.

Bandwidth to support TUAS is at a premium, especially on smaller naval ships because of

the number of communication requirements that exist to meet operational commitments. This bandwidth limitation can potentially impact the types of payloads employed on TUAS and it definitely restricts the number of TUAS platforms that can be airborne conducting ISR and other support missions to one vehicle.³⁷ A second unmanned aircraft can be airborne en route to relieve the on station asset but bandwidth limitations prevent any data other than flight control info from being passed. These communication and bandwidth issues are a vulnerability of the system but are manageable and normally do not prevent mission completion. Future development to enhance TUAS communication suites will help overcome many of these limitations.

Airspace management is another problem with TUAS. Since these systems are unmanned, it is the ground station operator who must ensure flight safety albeit the operator does not have a 360 degree view and no onboard instruments to detect other aircraft which can make safety of flight difficult. There are several mitigating procedures to be followed to prevent any type of flight mishap. First, the TUAS operator must coordinate with shipboard radar operators to ensure safety of flight de-confliction just like what is done during manned aircraft operations. Second, TUAS may be assigned a geographical airspace box or an altitude range to operate in that is normally below the operating altitudes of most fixed wing aircraft. Third, the use of Identification Friend or Foe (IFF), available to TUAS, should be utilized. Finally, the TUAS flight will normally be scheduled in the daily Air Tasking Order (ATO) so other military aircraft will have visibility on its airspace presence. There are several technical solutions that can help airspace de-confliction as well. The addition of anti-collision lights, and onboard “sense and avoid” systems can also help prevent an airborne mishap.³⁸ Future TUAS should have these safety features installed. Airspace management

will likely become more difficult in the future as the skies become more congested by the increase employment of Unmanned Aerial Systems.

TUAS is not a wide area view ISR asset like reconnaissance satellites or ground based, high altitude, unmanned aerial systems like the Air Force Global Hawk. TUAS may require outside intelligence support for mission planning to help identify and localize the area to be searched or monitored.

TUAS can be more susceptible to inclement weather involving thunderstorms, icing and turbulence than manned aircraft or larger unmanned aerial systems.³⁹ The smaller airframe and reduced weight contributes to this. The trade off for this is fuel efficiency and increased on station time over manned aircraft.

The limited speed of TUAS as compared to manned aircraft is another shortfall that may be a factor when considering dynamic re-tasking and the prosecution of time-sensitive targets. Transit time and repositioning of TUAS may not be achieved as quickly.

The Navy lacks trained TUAS military operators to deploy with these systems. Defense contractors currently provide the requisite expertise to operate and maintain TUAS in deployed strike groups. This training deficiency is easily overcome once a target group of military operators are identified and trained on this emerging technology to replace the civilian operator and maintainers. The Navy should realize cost savings in the long run from this approach over the current contracting of services.

All of these TUAS shortfalls are resolvable through continued engineering development, training programs and proper implementation of techniques and procedures. Additionally, none of these shortfalls prevent TUAS from providing the required ISR and

knowledge management support relevant throughout the range of military operations to both the tactical and operational commander.

NAVY WAY AHEAD FOR TACTICAL UNMANNED AERIAL SYSTEMS

Tactical unmanned aerial systems are not a new concept for the Navy. They have been in existence for over a quarter of a century, but the problem with putting them on small combatants was the inability to land. Today's TUAS have overcome these problems with unique recovery methods or vertical landing capabilities.

The Navy's way ahead for TUAS is focused on two systems in the near and long term. The current TUAS in operation today is capable of providing the required persistent ISR and other adaptable force package options discussed previously. It is currently being used on a limited basis in some LSDs, LPDs, LHAs, DDGs and T-AKs on a rotating basis dependent on deployment schedules and operational commitments. The system is being used to partially fill the tactical ISR capability gap on an interim basis and is expected to be replaced by a joint unmanned aerial system (UAS) in FY 2011.

This joint UAS will be a tactical, expeditionary, long endurance TUAS capable of multiple missions. It will have advanced target acquisition and fire support capability. It will begin technical demonstration in FY 2009 and a baseline capability will reach IOC in FY 2011 predicated on funding and continued support.⁴⁰

The Navy is also developing a Vertical take-off and landing Tactical Unmanned Air Vehicle (VTUAV) designed to operate from all air-capable ships. Initially, it will primarily deploy on the new Littoral Combat Ship (LCS), providing a significantly improved organic surveillance capability. It will include day and night real-time Reconnaissance Surveillance and Target Acquisition (RSTA), communications relay with off board sensors (such as the

MH-60R/S and unmanned surface and underwater vehicles), and battlefield management of Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASUW), and Mine Warfare (MIW) operations. With a vehicle endurance of more than five hours, a VTUAV, comprised of three air vehicles rotating on and off station, will be capable of twelve continuous hours of operation as far as 110 nautical miles from the launch site.⁴¹ The Navy strategy to embark VTUAV as an embedded system onboard LCS to achieve full integration in the combat system demonstrates a commitment to expand the future use of TUAS operations in the littoral on at least this class of ship. The same commitment is needed for retrofitting all small capital ships with a TUAS capability in the long term.

In 2002, Commander, Naval Surface Forces identified the requirement for TUAS (then called Tactical Unmanned Aerial Vehicles (TUAV)) to be on all air capable ships.

Commander, U.S. Fleet Forces endorsed this requirement in 2003 stating:

TUAVs are the means by which we will gather intelligence to support strike, cue force protection assets and target long range fires in support of Marines or Special Operating Forces ashore. CFFC views TUAVs as a force multiplier in the ISR, SIGINT and time sensitive missions that will significantly extend the horizon of naval forces. We need the enhanced situational awareness provided by TUAVs to fight and win in the littoral.⁴²

This requirement remains unfulfilled.

CONCLUSIONS/ RECOMMENDATIONS

The Navy needs to overcome tactical ISR asset shortfalls resident in deploying strike groups so they can better support the Maritime Domain Awareness picture of the operational commander. MDA is the key to providing combatant commanders the necessary information to make effective decisions against maritime threats to help maintain political and economic stability in volatile regions around the world. The solution for solving this tactical ISR asset shortfall is Tactical Unmanned Aerial Systems. The

capabilities of TUAS to fulfill tactical ISR requirements have been demonstrated repeatedly, on multiple Navy combatants over the past several years as seen specifically in the CENTCOM AOR. The U.S. Navy needs to expand its use of TUAS in strike groups to meet tactical ISR asset demands. Naval strike groups are routinely deployed in support of combatant commanders without these requisite organic tools to achieve persistent maritime surveillance and information superiority, and the addition of TUAS can correct that deficiency. TUAS should be installed on all small deck combatants so strike groups will not be impacted by disaggregated operations when tasked. The Navy needs to institute a TUAS training program to transition TUAS operations from contractors to military operators establishing a pool of trained experts for future operations. The expanded use of TUAS in Navy strike groups is the clear answer to solving tactical ISR shortfalls and helping achieve knowledge and information superiority for Maritime Domain Awareness at the tactical and operational level.

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¹¹ *Ibid.*, ii.

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¹⁴ *Ibid.*, 2.

¹⁵ *Ibid.*, 3.

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